REINHOLD ENVIRONMENTAL Ltd.

2015 APC Round Table & Expo Presentation

July 13 & 14, 2015, in Atlanta, GA / Hosted by Southern Company

ESP Rapping Troubleshooting and Optimization

APC Round Table & Expo

Tuesday July 14, 2015

Atlanta, GA

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AIR TEK

RAPPING BASICS

Rapping Necessities

- Keep gas flow distribution media clean
- Dislodge material from collector plates
- Dislodge material from discharge electrodes

Goals of Rapping

- Remove particulate at a rate equal to collection while:
  - Minimizing Re-entrainment
  - Maximizing power
  - Minimizing opacity
  - Minimizing mechanical wear

Rapping Designs

External Rapping

- Electromagnetic Impulse Rappers
- Electric Vibrators
- Pneumatic Vibrators
- Drop Rod Rapper

Internal Rapping

- Tumbling Hammer
- Mechanical Stroke
- Sonic Horn

External Rapping Configuration

Pros:

- Low maintenance
- Good sectionalization
- Maximum adjustments
- Repairs completed on the run

Cons:

- Roof penetrations
- Extensive wiring required
- “Complicated” programming

External Rapping Installation Considerations

Mechanical

- Rapper Type
- Sectionalization
- Piston Exposure
- Plumbness
- Roof Penetration Seal
- Rapper Rod Connection

Electrical

- Rapper Panel Location
- Wiring Method
- Programming
  - Intensity
  - Clock Time
  - Tandem Rapping
  - Multiple Raps

External Rapping General Maintenance

- Routine walk down of rappers
  - Operating with design lift and interval
- Ensure ground strap secure
- Ensure shaft is sealed
- Mechanical installation
  - Plumb
  - Piston exposure
  - Hardware secure
- Electrical installation
  - Wiring protected
  - Connections tight

Internal Rapping Configuration

Pros:

- Applies force to bottom of plate
- Limited roof penetrations
- Limited wiring required

Cons:

- High maintenance
- Limited adjustment
- Most components internal
- Mechanical failure more likely
- Wasted internal area

Internal Rapping Installation Considerations

Mechanical

- Alignment
  - Shafts
  - Hammers
  - Pinwheels
  - Motor
- Keyed Properly
- Gearbox Selection

Electrical

- Motor Starter MCC Space
- Torque/Amp Monitor
- Ensure Proper Rotation

Internal Rapping General Maintenance

- Mechanical Wear
  - Hammers
  - Shafts
  - Bearings
  - Couplings
  - Pinwheels
  - Shock Bar / Tubes
- Alignment




In Honor of Our Trip To Atlanta, Foxworthy's Guide To Rapping Issues

- If your stack reminds you of a scene from An Inconvenient Truth, you might be rapping poorly
- If your power levels resemble the stock market circa 2008, you might be rapping poorly
- If your T/R sets have more trips than a Woodstock reunion, you might be rapping poorly

Why Ineffective Rapping Hurts Performance

- Reduces Electrical Clearance
- Suppresses Corona Generation
- Can Compound Back Corona
- Compounds as Latter Fields Realize a Greater Load
- Mechanical Failure Causes Other System Problems

External Rapping Troubleshooting

Common Failure Modes

- Open/Short Circuit – Causes a fault in the rapper panel. Isolate the three potential sources of the issue (rapper, wiring, control) and verify resistances of each.
- Internal Mechanical Failure – Causes the rapper rod to fall in the rapper sleeve and piston fall out of energization zone. Enter precipitator to repair the damaged component.
- Phenolic Tube Worn – Causes the piston to hang up in the rapper dampening the rapping force. Replace rapper coil.
- Piston Exposure Compromised – Effects rapping force. Reset rapper to proper height.
- Rapper Panel Malfunction – In general, causes a single rapper, single card, or entire system to fail. Most effective approach is to change the component associated with magnitude of failure.
- Magnetization – Magnet clamping force cannot be overcome by electromagnetic lifting force. Install piston with stainless steel tip.

INTERNAL RAPPING TROUBLESHOOTING

Common Failure Modes

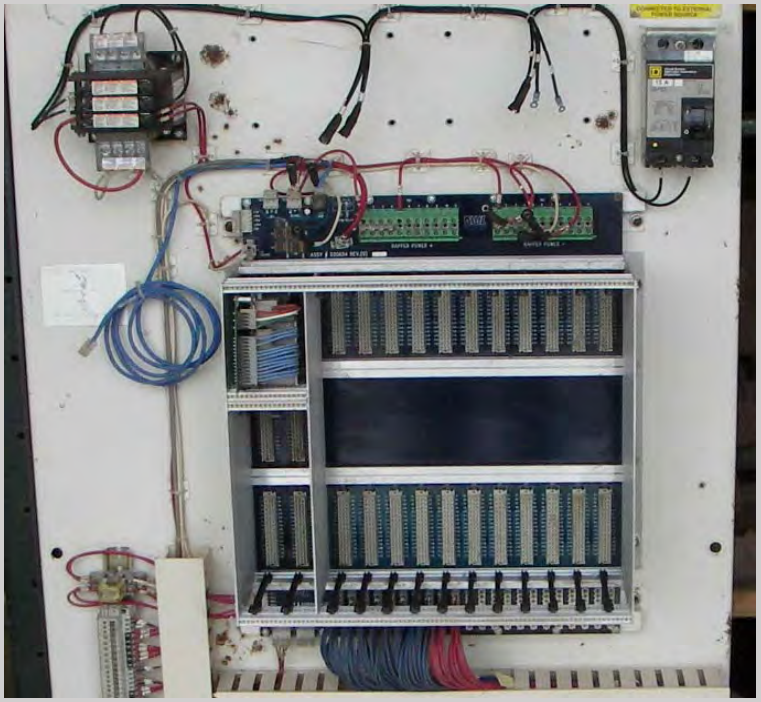
- Internal Mechanical Failure – Can result in grounded field, ineffective rapping, and plugged hopper. Enter the precipitator to identify and repair damaged component.
- Drive Failure – Results in the loss of a large percentage of collecting area rapping. Identify and repair damaged component.
- Rapper Panel or Hammer Board Malfunction – In general, causes a single rapper, single card, or entire system to fail. Most effective approach is to change the component associated with the failure.

RAPPER PANEL TROUBLESHOOTING

Common Failure Modes

- Card Failures
- Program Issues
  - Lost Programs
  - Clock/Transformer Overload
  - Programming Not Matching Field
- Communication Glitches
- Blown Fuses

- Isolate Before Troubleshooting



EXTERNAL

GROUP NO	RAPPER TYPE	INITIAL WAIT			CYCLE TIME			WAIT			OUTPUTS			RAPPER ROD LIFT SETTING	NUMBER OF RAPS
		HRS	MIN	SEC	HRS	MIN	SEC	HRS	MIN	SEC	RAPPER	ACG	RAPPER		
(1 - 50)		(0-24)	(0-59)	(0-59)	(0-24)	(0-59)	(0-59)	(0-24)	(0-59)	(0-59)	NUMBER	GROUP	NAME	(INCHES)	
1	IMPULSE	00	00	01	00	01	55	00	00	00	1 - 20	1	1P1-1P20	5.0	2
2	IMPULSE	00	00	01	00	01	55	00	00	00	129 - 148	2	1P21-1P40	5.0	2
3	IMPULSE	00	00	03	00	04	33	00	00	00	21 - 40	1	2P1-2P20	4.5	1
4	IMPULSE	00	00	03	00	04	33	00	00	00	149 - 168	2	2P21-2P40	4.5	1
5	IMPULSE	00	00	05	00	24	21	00	00	00	41 - 60	3	3P1-3P20	4.5	1
6	IMPULSE	00	00	05	00	24	21	00	00	00	169 - 188	4	3P21-3P40	4.5	1
7	IMPULSE	00	00	07	01	13	04	00	00	00	61 - 80	3	4P1-4P20	4.5	1
8	IMPULSE	00	00	07	01	13	04	00	00	00	189 - 208	4	4P21-4P40	4.5	1
9	IMPULSE	00	00	09	00	02	27	00	00	00	81 - 112	0	WEST HV	4.0	1
10	IMPULSE	00	00	09	00	02	27	00	00	00	209 - 240	0	EAST HV	4.0	1
11	IMPULSE	00	00	11	00	03	33	00	00	00	113 - 118	0	DP1-DP6	5.0	2
12	IMPULSE	00	00	13	02	23	13	00	00	00	241 - 246	0	PP1-PP6	5.0	2

INTERNAL

GROUP NO	RAPPER TYPE				ON TIME			WAIT			OUTPUTS				
					HRS	MIN	SEC	HRS	MIN	SEC	RAPPER	ACG	RAPPER		
(1 - 50)					(0-24)	(0-59)	(0-59)	(0-24)	(0-59)	(0-59)	NUMBER	GROUP	NAME		
1	HAMMER				00	01	05	00	00	50	1	N/A	1CP		
2	HAMMER				00	01	05	00	3	28	2	N/A	2CP		
3	HAMMER				00	01	05	00	23	16	3	N/A	3CP		
4	HAMMER				00	00	20	00	18	01	4	N/A	4CP		
5	HAMMER				00	01	05	00	01	20	5	N/A	1HV		
6	HAMMER				00	01	05	00	02	22	6	N/A	2HV		
7	HAMMER				00	01	05	00	03	33	7	N/A	3HV		
8	HAMMER				00	01	05	00	04	44	8	N/A	4HV		
9	HAMMER				00	01	05	00	02	28	9	N/A	DP		
10	HAMMER				00	01	05	02	22	08	10	N/A	PP		

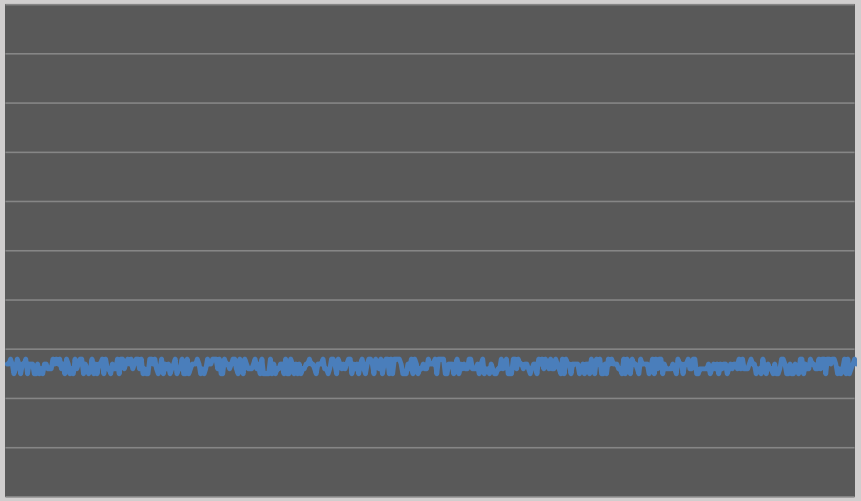
Optimizing Rapping – Systematic Approach

- Should be completed on full load at a steady-state
- Begin with faster/more intense rapping than anticipated
- Progressively slow rapper cycle time in the inlet field until power begins to degrade
- Speed up rapper cycle time slightly to “stay ahead” of power degradation
- Progressively decrease intensity in same manner
- Once complete with inlet field, repeat on each remaining field
- As you progress through the precipitator, emphasis will shift from power levels to opacity baseline/spikes
- Should be completed over numerous days to ensure equilibrium is reached before evaluation
- Provides maximum performance with minimum mechanical wear

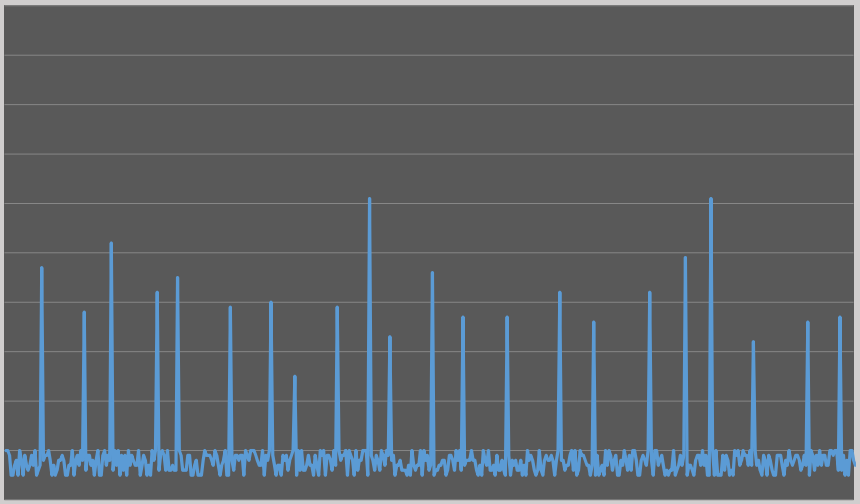
Optimizing Rapping

A well designed rapping program will maximize power in each field with the lowest baseline and minimal spiking

High Baseline With Few Spikes

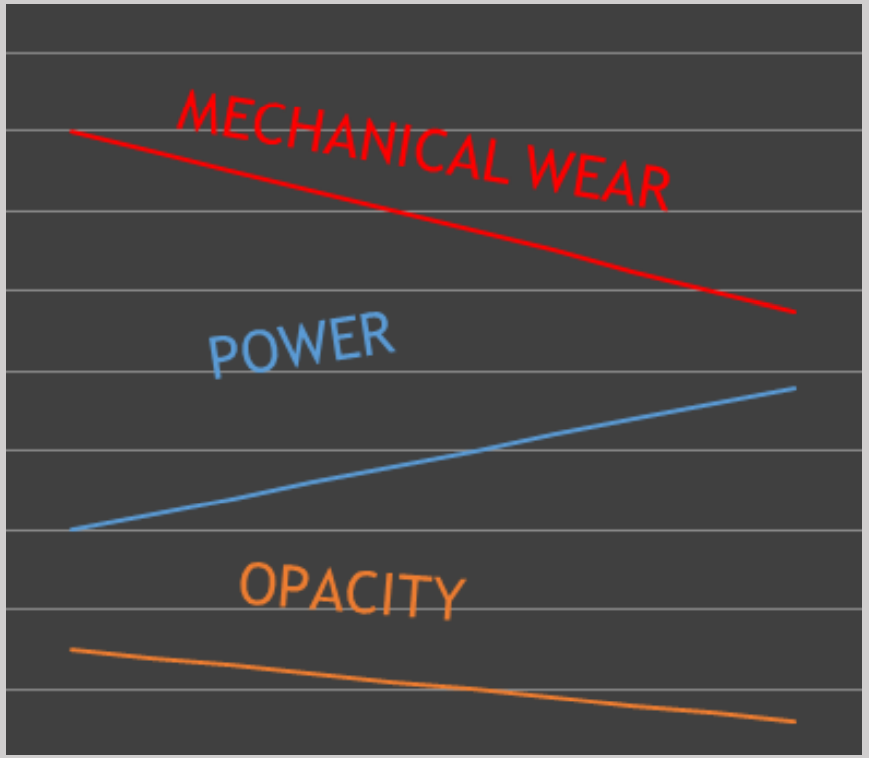


Low Baseline With High Spikes



Optimizing Rapping – Bells And Whistles

- Utilizing Multiple Rapper Programs
  - Full Load
  - Reduced Load
  - Heavy Cleaning
  - Maintenance Walkdown
- Power Off Rapping For High Resistivity Flyash
- Automatic Program Changes



THANK YOU FOR YOUR TIME

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Questions?

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